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ABSTRACT

The results of the Mathematics Skills Improvement Project used with about 2,000 low-achieving students in grades three through six are reported. The services of 35 mathematics consultants were provided for 36 schools. Data obtained (using the California Test of Basic Skills) on pupil achievement for one year in the project indicated that project participants achieved significantly greater gains than did comparable pupils not participating in the project. However, data obtained on pupil achievement for two years of service in the project indicated no significant differences in achievement. Implementation of process objectives of the project in relation to the extent of services to pupils and communication with classroom teachers and pupils' families are discussed briefly. (DT)

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MATHEMATICS SKILLS IMPROVEMENT PROJECT

TITLE I

FUND 58 COMPONENT 6

1971 - 72 EVALUATION

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MATHEMATICS SKILLS IMPROVEMENT PROJECT

I. INTRODUCTION

By the time a pupil leaves the elementary school, it is assumed that he has achieved a basic level of competency in arithmetic. When this competency is not achieved, the pupil will face great difficulties in school work required at the secondary level. Therefore an additional effort by elementary schools is of critical importance in order to aid the upper elementary school pupil whose achievement is more than one year below the national norms.

For the past four years the Mathematics Skills Improvement Project has assigned specially trained mathematics consultants to work with small groups of low-achieving pupils in selected Title I schools. The project has provided intensive instruction for 40 minutes a day for these pupils in a specially equipped mathematics laboratory.

During the 1971-72 school year there were over 3,500 pupils in 36 elementary schools from grades 3, 4, 5, and 6, whose achievement in mathematics was documented to be one year or more below their grade level. Through the services of this project approximately 2,000 of these pupils received additional instruction in mathematics in an effort to bring their achievement up to a functional level and make future success in school work more possible.

The implementation of this project involved objectives on two levels: process objectives which related to the procedures of the proposal, and product objectives which related to student behavioral changes. The process objectives which related to the degree the project was implemented include:

1. To provide 60 low-achieving students in each target Title I school in grades 3, 4, 5, and 6 with one 40-minute period each day for one semester or one year of small group instruction in mathematics;

2. To provide consultative services at least two times during the school year to 50% of the classroom teachers who have students in the Mathematics Skills Improvement Project;

3. To communicate so effectively with project participants' families that 75% of the parents when questioned will acknowledge being contacted and be able to identify the type contact which has been made to them.

Product objectives delineated the behavioral changes that were expected from implementation of the process objectives. These objectives were measured by a comparison of test scores from standardized arithmetic tests given in September, January and May to pupils assigned to experimental and control groups. The product objectives were specified as follows:

1. To improve significantly ($p < .05$) achievement in arithmetic of experimental as compared to control students as measured by CTBS test of Arithmetic Computation and Concepts;

2. To increase achievement in mathematics of at least 2/3 of the experimental students by 0.45 grade equivalent score for each semester of involvement or 0.90 grade equivalent score for a nine month period of involvement as measured by pre and post testing using CTBS arithmetic tests for computation and concepts.

3. To improve significantly ($p < .05$) student attitudes toward arithmetic as evidenced by pre and post testing using a semantic differential instrument with concepts relating to arithmetic.

B. Historical Background

The Mathematics Skills Improvement Project was started in 17 target Title I schools in the spring of 1968. Numbers of schools and approximate numbers of pupils included in the

project for the past four and one half years are as follows:

Spring 1968	- 17 schools	- 1,200 pupils
1968-69	- 29 schools	- 1,620 pupils
Fall 1969	- 21 schools	- 1,200 pupils
Spring 1970	- 27 schools	- 1,500 pupils
1970-71	- 30 schools	- 1,740 pupils
1971-72	- 36 schools	- 2,070 pupils

Two parochial schools are included in these figures for the school years of 1968-69, 1970-71, and one parochial school in 1971-72. These schools were served by one consultant who spent half a day in each school and taught 30 pupils in each building.

C. Summary of Operations

During the 1971-72 school 68 elementary schools qualified as eligible for Title I services. In addition to Mathematics Consultants who were assigned to the 30 schools served the previous year, six additional consultants were employed for serving six more schools. Schools were selected on the basis of poverty level of the students, student achievement in mathematics, and the availability of a room appropriate to be utilized as a mathematics laboratory. Thirty-five consultants served the 34 schools, with one large school, Hazeldell, having 170 eligible pupils, being served by two mathematics consultants and two laboratories. Two consultants each served two schools which had less than 60 pupils eligible for the services.

Pupils were identified for the services of this project on the basis of standarized test results when available. For pupils with no recorded achievement data, evidence of previous failure in mathematics and teacher or principal recommendation were utilized.

Based on these criteria, 3,464 pupils qualified for the services of this project. TABLE I below lists the actual numbers of pupils who were served for varying lengths of time.

TABLE I

NUMBERS OF PUPILS SERVED
1971-72

	Number	Per Cent
Total number pupils Eligible for service	3,464	--
Served:		
2 Semesters	1,684	48.6
1 Semester	651	18.8
Less than 1 semester (Mobility)	243	7.0
Total Served	2,578	74.4

The total cost of the project was $597,543 for the total year, of which $17,069 was spent for the summer school portion. Regular mathematics instruction of 40 minutes a day in the elementary school would be valued at approximately $67.00 per pupil. Pupils receiving Mathematics Skills Improvement instruction received both the regular 40 minutes a day of classroom instruction plus an additional 40 minutes a day of work in the mathematics laboratory with the mathematics consultant. The cost of instruction for these pupils is presented in TABLE II.

TABLE II

PER PUPIL COST RELATED TO MATHEMATICS ACHIEVEMENT

	Year Cost/Pupil	Pre-Post Achievement Gain:Grade Placement	$/Mo. Gain
Mathematics Skills Project Pupils (Experimental)	$280.42	3 months*	$93.47
Low Achieving Classroom Pupils (Control)	$ 67.00	7 months	$ 9.57
Mathematics Skills Project Pupils: Total Service	$347.42	10 months*	$34.74

* Total gain for experimental pupils was 10 months. Of this gain, seven months could have been made in the regular class. Therefore only the incremental gain of three months can be attributed to Mathematics Skills Improvement Project.

D. Questions To Be Answered By Evaluation

The questions which this evaluation will answer, related to process and product objectives, are as follows:

1. Did pupils served by the project improve in achievement more than comparable pupils in regular classrooms?

2. Was this difference in achievement between experimental and control pupils evident at the end of two year's instruction?

3. Did two out of three experimental pupils improve their grade placement achievement 0.10 for each month of service?

4. Did each school which had more than 60 eligible pupils, service an average of 60 pupils for each semester of the 1971-72 school year?

5. Did the pupils served attend project classes at least 85% of the school days?

6. What per cent of the classroom teachers reported they had received some service from the mathematics consultant?

7. What per cent of the pupils' parents reported having been contacted by the Mathematics Consultant?

8. Did parents think their child was gaining in achievement, and liking mathematics more as a result of this project?

II. HIGHLIGHTS OF FINDINGS

The first three highlights relate to the achievement of pupils served by the project for one and two years. The last five of the highlights discuss the extent of implementation of process objectives which focus on the provision of services to eligible students.

1. Data obtained on pupil achievement for one year of service in the Mathematics Skills Improvement Project indicated:

   - Pupils in grades 3, 4, 5 and 6 who participated in the project for the 1971-72 school year achieved significantly greater gains than did comparable pupils who did not participate in the project.

AVERAGE GAINS IN GRADE EQUIVALENT SCORES

Grades 3, 4, 5, 6

CTBS Arithmetic Score	Mathematics Skills Improvement Pupils	Low-Achieving Classroom Pupils
Computation*	11.5 months	8.8 months
Concepts*	8.0 months	3.8 months

*Eight months between pre and post testing.

   - Forty-seven per cent of the pupils in the program for one full school year as compared with 36 per cent of the pupils in the control group achieved gains sufficient to place their arithmetic achievement at or above the fourth stanine nationally.

   - Pupils in grade 2 who participated in the project for the 1971-72 school year achieved gains which were not significantly greater than those of control pupils in the regular classroom.

AVERAGE GAINS IN GRADE EQUIVALENT SCORES

Grade 2

Stanford Arithmetic Score	Mathematics Skills Improvement Pupils	Low-Achieving Classroom Pupils
Gain ($\bar{X}$)	4 months	4 months

*Eight months between pre and post testing.

2. Data obtained on pupil achievement for two years of service in the project indicated there was no significant difference in achievement for pupils receiving the services of the mathematics consultant and pupils in the regular classroom at the end of the second year.

   - Pupils in grades 3-4, 4-5, and 5-6 who participated in the project for the 1970-71 and 1971-72 school years did not achieve gains significantly greater than the comparable pupils in the classroom for the same two years.

AVERAGE GAINS IN GRADE EQUIVALENT SCORES

CTBS Arithmetic Scores	Mathematics Skills Improvement Pupils	Low-Achieving Classroom Pupils
Computation*	18.3 months	16.7 months
Concepts*	14.3 months	12.0 months

*Nineteen months between pre and post testing.

   - At the end of the second year, 22 per cent of the pupils who had been in the project continuously and 21 per cent of the pupils in the control group achieved scores which placed them in the fourth stanine nationally.

3. More than two-thirds of the pupils in grades 3 and 4 who were receiving project services were able to make gains in achievement of one month for each month of service. However, only half the pupils in grades 5 and 6 who were receiving project services made gains of one month for each month of service. This objective for pupil achievement was met by pupils in only two of the four grades.

The following Highlights of Findings are concerned with the implementation of process objectives in relation to the extent of services to pupils and communication with classroom teachers and pupils' families.

4. The high rate of pupil mobility resulted in only 14 of the 32 schools, which had more than 65 eligible pupils, being able to serve 60 or more pupils for the complete fall semester of 1971. Pupil mobility apparently was less in the spring semester when 20 of the 32 schools were able to maintain registers containing over 60 pupils. Even though all consultants had been assigned 65 pupils in September and February in anticipation of the mobility loss of students, this objective was not met.

5. No consultant was able to achieve the objective of having pupils in attendance an average of 85 per cent of the school days. Attendance of pupils in the math laboratory when averaged by school indicated attendance ranging from 57 per cent to 80 per cent of the school days.

6. Over 93 per cent of the classroom teachers interviewed by an independent interviewing firm acknowledged there had been repeated discussions between themselves and the mathematics consultant concerning pupil progress in mathematics. Also 93 per cent of the teachers contacted stated that they found such discussions of value to their work with the pupils.

7. Seventy-five per cent of the parents responding to a questionnaire acknowledged having been contacted by the mathematics consultant during the school year concerning their child's progress in mathematics. Seventy-eight per cent of these parents remembered materials related to mathematics which their child had brought home from school.

8. Over 96 per cent of the parents said they believed the special instruction had helped their child improve in mathematics. Comments made by parents on the questionnaire noted more than half the pupils appeared to like the project classes; less than one-fourth of the parents commented that their child still did not like mathematics or the Mathematics Skills Classes.

IMPLICATIONS

The analysis of one school year's achievement documented significant differences in achievement between experimental and control groups of pupils. Achievement data recorded in September noted that approximately 10 per cent of the eligible pupils scored above the 25th percentile nationally on their pre scores. By the end of the school year, 47 per cent of the experimental group and 36 per cent of the control group achieved scores which placed them above the 25th percentile. This would indicate that the consultant's work in the schools made it possible for additional numbers of both experimental and control pupils to begin achieving within the normal range with pupils in the experimental group making the greater gains.

The analysis of two-year achievement data noted the non-significant difference in gains between experimental and control groups of pupils. It also noted that at the end of two years 22 per cent of the experimental pupils and 21 per cent of the control pupils achieved scores above the 25th percentile. Of the pupils in the experimental group, only 2.5 per cent started with scores above the 25th percentile, while 10 per cent of the control pupils achieved pre scores at this level.

The fact that after two years of service an additional 20 per cent of the experimental pupils, who were apparently the lowest achievers on the eligibility list, were able to achieve scores above the 25th percentile should be considered a positive outcome.

However in the two year analysis there was noted a sizable regression in achievement scores of pupils in the experimental group from the May testing to September testing. This regression in test scores of pupils receiving the additional mathematics instruction implies á learning which the student has not yet incorporated as an integral part of his own knowledge and therefore does not retain over the summer months.

Neither part of the process objective which stated that 60 pupils in each school would receive instruction 85 per cent of the school day was met. Pupil mobility appeared to prevent the maintenance of enrollment of 60 even though a beginning assignment of 65 pupils to each consultant was made. This may indicate the need for assigning pupils to project services additional times during the fall semester so as to service the maximum possible number of pupils. The average pupils' attendance for each school being below 85 per cent of the school days indicated that pupils were not receiving the intensity of instruction which had been anticipated.

RECOMMENDATIONS

The lack of long term retention and stability of achievement, particularly in the computational area for the experimental pupils, would appear to indicate this phase of arithmetic knowledge has not become a real part of the pupil's own knowledge. Perhaps a greater effort needs to be made to determine from the student's point of view what is important mathematically to him. If the student's interests and needs could become the basis for mathematics instruction, he might not only learn more efficiently, but might retain the knowledge for a longer period of time.

Project services to second grade pupils should be discontinued. Three years ago experimental instruction was also attempted for second grade pupils in two other schools with the same lack of any evident results.

In schools which experience a high rate of pupil mobility, there should be established additional entry times during the fall semester for pupils to begin Mathematics Skills Instruction.

The fact that consultant absence from the classroom is one element which makes services of the project less available to the pupils needs to be studied and possible changes in scheduling workshops or consultant meetings might be considered.

III. DESCRIPTION OF PROJECT

This project provided services of 35 mathematics consultants in a total of 36 schools. In 32 of the schools, consultants were assigned 65 low achieving pupils in grades 3, 4, 5, or 6. The mobility of the student population affected the numbers of pupils served so that by January there were fewer than 60 pupils being served in 18 of the 32 schools.

At the beginning of the second semester, consultants were assigned additional pupils so that once again they started to serve 65 pupils. By June, once again in 10 schools the pupil mobility caused the numbers of pupils assigned to this project to drop to below 60.

One school, serving primary pupils only, was assigned 30 second grade pupils and 30 third grade pupils for the services of the project. The work with second grade pupils was a pilot experiment to determine whether the additional work in a mathematics laboratory for young pupils would prevent their falling further behind their classmates. Four other schools, with smaller enrollments, were assigned consultant services for half a day each. In these schools, the consultants were assigned 20 to 30 pupils, depending on the numbers of pupils eligible for services.

In all schools, the following criteria were used to identify children who were eligible for project participation:

1. One or more years below grade level on the most recent standardized testing;

2. Failure in arithmetic during the previous year;

3. Teacher and/or principal recommendation.

In the 32 larger schools there were more than 65 pupils eligible for the services of this project. Since all pupils on the eligibility list were in need of remediation, random assignment was chosen as the most equitable method for selecting pupils to receive the project services. Pupils not chosen to receive remedial services starting in September were placed on the list of control pupils to be tested and to be replacements for children moving from the school. This replacement of pupils was done at the end of the first semester.

In all target schools a room was equipped as a mathematics laboratory and was used by the mathematics consultant for the Mathematics Skills Improvement Project.

Pupils assigned to the project were moved from their regular classroom to the mathematics laboratory for a 40-minute instruction period every day. Each instructional group consisted of eight to twelve pupils who were functioning on a similar plane of competence

The instruction period offered a variety of activities and intensive work with manipulative devices. Pupils might be working in small groups or individually, depending upon each pupil's needs. Consultants worked to provide pupils with a basic understanding of the numbering system in addition to the specific steps involved in computational skills.

Mathematics consultants maintained continuous contact with each pupil's classroom teacher so that both classroom teachers and

mathematics consultants were aware of the pupil's progress and areas of weakness. Consultants also shared with classroom teachers techniques they had found valuable in teaching low-achievers. Indirect help was thus provided to the control pupil who remained in the regular classroom.

Parents of pupils in mathematics skills improvement were contacted in many different fashions. Parent-teacher conferences, letters and phone calls were utilized heavily. In each school a parent advisory committee for the mathematics skills project was organized. The purpose of this group was to provide parents with an organization which could learn more about the instruction being given to their children, to provide helps for the parents to utilize at home, and to offer to parents the opportunity to become involved as a volunteer in tutoring children in the mathematics laboratory. As a result of these activities involving parents, many consultants and parents maintained repeated contacts during the entire school year.

IV. EVALUATION

Evaluation of the project was based on the process objectives which noted the extent to which project services were delivered to the students, and product objectives which analyzed the level of student achievement in mathematics. The first process objective was as follows:

Process Objective 1: To provide 60 low achieving students in each target Title I school in grades 3, 4, 5, 6, with one 40-minute period each day for one semester or one school year with small group instruction in mathematics.

The criterion stated that all target schools will have 60 pupils assigned to Mathematics Skills Improvement Project for the school year. Students assigned to Mathematics Skills Improvement Project will be in attendance in the project classes a minimum of 85% of school days during their assignment to the Project.

In 32 of the project schools there were sufficient numbers of eligible students at the beginning of each semester so that it was possible to assign 65 pupils to the project. The other four schools with less than 65 eligible pupils were assigned 20 to 30 pupils each. During the semester, the mobility of students caused an attrition in numbers of students being served, which resulted in an average enrollment for the full service schools of 55 students for the fall semester, and 60 students for the spring semester.

Pupil attendance in the project was computed for each school for only those pupils who were enrolled for the complete school year. These data are tabulated in Appendix B. It may be noted that no school achieved a mean attendance which met the criterion of 153 days or 85% of the school days. Actual attendance of pupils in the mathematics

laboratories averaged 124 days or 69% of the school days. It should be noted that studen attendance, is affected not only by the pupil's own absence, but also by the Mathematics Consultant's absence, and by any all-school activity such as concert attendance, school camping, etc. It is possible the criterion was set too high. But it must also be noted that if pupils realistically will receive instruction about two-thirds of the time, perhaps the achievement goals are also too high. A review of project objectives with their criteria need to be made and adjusted as needed to be realistic within the actual school instruction.

Process Objective 2: To provide consultative service to 50% of the classroom teachers in each school who have students in the Mathematics Skills Improvement Project at least two times during the school year. The criterion for meeting this objective was that 50% of the teachers would report at least two instances of consultative services during the year.

An independent research firm was contracted to interview teachers and principals in 17 schools to obtain their opinions and reactions concerning the Mathematics Skills Improvement Project. Fifty-nine of the 63 teachers and all of the seven principals interviewed about the Mathematics Skills Improvement Project stated there had been discussions concerning pupil mathematics progress between teacher and the Mathematics Consultants. Fifty-five of the 59 teachers found these discussions of value, for reasons such as the following:

"I was given much good advice."
"The Consultant helps me work better with the individual child."
"We come to a conclusion on the problem of the child."

The value of discussions with the consultant appeared to reside chiefly in the opportunity these discussions provided for coordinating classroom and math lab work, in the ideas gained for teaching the regular class, in the opportunity for checking on the progress of individual children, and in the teachers' learning from the consultant what the specific weaknesses of individual children were.

The principals reported that the exchange of ideas had occurred in the context of workshops and regular staff meetings as well as "whenever they are needed", "as often as possible", and "constantly". Every principal expressed highly favorable attitudes toward these exchanges.

It would appear from the interviews conducted by the private interviewing firm that the objective of 50% of the teachers being contacted by the mathematics consultants was more than met. It also would appear that in the majority of instances, contacts between consultants and teachers occurred repeatedly and frequently. This objective was achieved.

Process Objective 3: To communicate so effectively with project participants' families that 75% of the parents, when questioned, will acknowledge being contacted and be able to identify the type of contact which has been made to them.

The criterion for this objective was that 75% of the families of project participants would acknowledge being contacted at least once during the school year. Of the families who had been contacted, 50% could report that the pupil had brought home and used an aid or material related to mathematics.

Questionnaires were taken home by 10 to 12 project participants attending 14 of the 36 schools to obtain their parent's perceptions of the project. From these questionnaires, 75% (118 out of 158) of the parents reported having received written information from the school concerning this project. Mathematics Consultants, responding to a similar question reported sending over 5,600 letters to over 2,060 parents. Consultant data would indicate each parent received about two written communications from the school. The fact that 75% of the parents remembered receiving such communications appears like a reasonable number. (Appendix C, D).

Seventy-eight percent of the parents reported seeing papers or other evidence of mathematics materials which their child had brought home from school. Only two consultants reported sending home mathematics manipulative materials. It appears likely therefore, that material which parents had seen was homework or some other type of worksheet.

Thirty-eight per cent of the parents reported they had visited the mathematics laboratory. Consultants reported 596 classroom visits by parents. Since each parental visit might represent 1, 2 or 3 pupils, it would be difficult to determine, from the consultant's data, what percentage of the parents had visited. From the sampling of parent responses the visitation varied from one school in which no parent reported visiting the mathematics laboratory, to another school which 82% of the parents had been for a visit.

It would appear from these data that an adequate number of contacts with parents were attempted during the school year. However, there appeared to be great variation in numbers of contacts and depth of contact from one school to another.

Product objective 1: To improve significantly ($p < .05$) achievement in arithmetic of experimental students as compared to control students as measured by CTBS test of Arithmetic Computation and Concepts.

Achievement of students in the experimental and control groups was compared for three different time periods:

1. Nine months: Sept. 1971 - May 1972: normal school year
2. Twelve months: Sept. 1970 - Sept. 1971: includes effect of summer vacation on achievement
3. Twenty months: Sept. 1970 - May 1972: includes effect of summer vacation and of on-going services

The first analysis which covered the normal school year used a random sample drawn from pupils who had taken all required achievement tests for the evaluation. Fifteen boys and 15 girls were selected for statistical analysis from the experimental and control groups for each grade level. This made a total sample for analysis of 240 pupils, 120 experimental and 120 control. This sample of pupil achievement scores was used for three statistical analyses: the complete school year for grades 3, 4, 5, and 6; the fall and spring semesters separately for grades 4, 5, and 6.

In the year analysis, the May 1972 achievement scores in computation and concepts were used in a multivariate analysis of covariance using the pupil's PLR and September achievement scores as covariates. The mean PLR for the total sample was 88.0. The pupil PLR by treatment group and grade level may be found in Appendix E. The analysis comparing pupil achievement of experimental and control groups reported an $F = 6.28$ which was significant at the .0005 level. In noting the results for each subdivision of the test, both the computation and concepts sections contributed to the significant F and each section also reported a

significant F result. TABLES I and II report the pupil achievement results in grade equivalent scores by grade level for arithmetic computation and arithmetic concepts for the 1971-72 school year.

TABLE I

ARITHMETIC COMPUTATION ACHIEVEMENT - CTBS TEST

Grades 3, 4, 5, 6

School Year 1971-72

Group	Mean Grade Equivalent Achievement Scores											
	Grade 3			Grade 4			Grade 5			Grade 6		
	Pre	Post	Chg.	Pre	Post	Chg.	Pre	Post	Chg.	Pre	Post	Chg.
Experimental	2.7	3.6	0.9	3.0	4.2	1.2	4.1	5.2	1.1	4.7	6.1	1.4
Control	2.7	3.3	0.6	3.0	4.0	1.0	4.0	4.7	0.7	4.7	5.9	1.2
Arithmetic Computation: $F = 11.02$ $p < .001$												

TABLE II

ARITHMETIC CONCEPTS ACHIEVEMENT - CTBS TEST

Grades 3, 4, 5, 6

School Year 1971-72

Group	Mean Grade Equivalent Achievement Scores											
	Grade 3			Grade 4			Grade 5			Grade 6		
	Pre	Post	Chg.	Pre	Post	Chg.	Pre	Post	Chg.	Pre	Post	Chg.
Experimental	2.1	2.8	0.7	2.6	3.4	0.8	3.2	4.0	0.8	3.8	4.7	0.9
Control	2.6	2.6	0.0	2.6	3.2	0.6	3.4	4.0	0.6	4.2	4.5	0.3
Arithmetic Concepts: $F = 4.40$ $p < .04$												

This statistical analysis indicates that achievement for the pupils in the experimental group in grades 3, 4, 5 and 6 was significantly better than achievement of pupils who were in the control group.

In one school, Rosedale, second grade pupils were served. These pupils were tested three times, September, February and May, using the Stanford Primary Test, Form W. TABLE III presents the data for these pupils.

TABLE III

ARITHMETIC ACHIEVEMENT - STANFORD PRIMARY I

Grade 2

Pupil Group:	Mean Grade Equivalent Achievement Scores		
	Sept.	Feb.	May
Experimental	1.4	1.6	1.8
Control	1.5	1.7	1.9

It may be observed that both groups gained four months in achievement, resulting in no apparent difference in achievement gains between the experimental and control groups of pupils. In 1969-70 experimental instruction of second grade pupils was attempted in two schools. At that time it was also concluded that at this age, this type of instruction apparently did not improve mathematics achievement to any notable extent. It is recommended again that instruction of second grade pupils be discontinued and the services of the Mathematics Skills Project be utilized for pupils in grades 3 through 6.

Pupil scores were then analyzed for each semester of the school year separately. Achievement of pupils in grade 3 was not included in this phase of the anaysis. Pre scores for third grade pupils are obtained from city-wide testing done late in November. Therefore it is not possible to measure progress for

either semester of the school year for these pupils. The computation scores for the fall semester and spring semester for grades 4, 5 and 6, indicated no significant difference in achievement between experimental and control groups for the fall, but a significant difference during the spring semester. TABLES IV and V report these data by grade level for both groups of pupils.

TABLE IV

ARITHMETIC COMPUTATION ACHIEVEMENT - CTBS TEST

Grades 4, 5, 6

Fall Semester - 1971

Group	Mean Grade Equivalent Achievement Scores								
	Grade 4			Grade 5			Grade 6		
	Sept.	Jan.	Gain	Sept.	Jan.	Gain	Sept.	Jan.	Gain
Experimental	3.0	3.8	0.8	4.1	4.5	0.4	4.7	5.7	1.0
Control	3.0	3.8	0.8	4.0	4.3	0.3	4.7	5.6	0.9
Fall Semester - Computation: F = 1.87 (nonsignificant)									

TABLE V

ARITHMETIC COMPUTATION ACHIEVEMENT - CTBS TEST

Grades 4, 5, 6

Spring Semester - 1972

Group	Mean Grade Equivalent Achievement Scores								
	Grade 4			Grade 5			Grade 6		
	Jan.	May	Gain	Jan.	May	Gain	Jan.	May	Gain
Experimental	3.8	4.2	0.4	4.5	5.2	0.7	5.7	6.1	0.4
Control	3.8	4.0	0.2	4.3	4.7	0.4	5.6	5.9	0.3
Spring Semester - Computation: F = 6.08 $p < .01$									

It may be noted that the greatest absolute gains in computational achievement were actually made during the fall semester of the school year. However, the pupils in both the experimental and control groups made these gains, therefore the analysis found no significant differences between the achievement of the two groups of pupils.

In the area of arithmetic concepts, the analysis of achievement data found no significant differences in achievement between experimental and control groups for either fall or spring semester of the school year. These data are reported in TABLES VI and VII,

TABLE VI

ARITHMETIC CONCEPTS ACHIEVEMENT - CTBS TEST

Grades 4, 5, 6

Fall Semester 1971

Group	Mean Grade Equivalent Achievement Scores								
	Grade 4			Grade 5			Grade 6		
	Sept.	Jan.	Gain	Sept.	Jan.	Gain	Sept.	Jan.	Gain
Experimental	2.6	2.8	0.2	3.2	3.4	0.2	3.8	4.9	1.1
Control	2.6	3.0	0.4	3.4	3.6	0.2	4.2	4.9	0.7
Fall Semester Concepts: F = 0.27 (nonsignificant)									

TABLE VII

ARITHMETIC CONCEPTS ACHIEVEMENT - CTBS TEST

Grades 4, 5, 6

Spring Semester - 1972

Group	Mean Grade Equivalent Achievement Scores								
	Grade 4			Grade 5			Grade 6		
	Jan.	May	Gain	Jan.	May	Gain	Jan.	May	Gain
Experimental	2.8	3.4	0.6	3.4	4.0	0.6	4.9	4.7	-0.2
Control	3.0	3.2	0.2	3.6	4.0	0.4	4.9	4.5	-0.4
Spring Semester Concepts: F = 2.36 (nonsignificant)									

The lack of significant difference in the experimental and control groups which is obtained when the two semesters are examined separately differs from the results obtained when the data for all four grades was examined for the complete year. Apparently the achievement of third grade pupils in the area of concepts was great enough so that it increased the F value enough to give an overall significance.

Chart I is a graphical presentation of these data. Projected on the graph is the rate of achievement of pupils in the experimental and control groups as well as a calculated anticipated rate of achievement. This anticipated rate of achievement was calculated assuming that the pupil rate of gain in achievement at the time of the pre test would continue. This rate was calculated by obtaining a ratio between the pupil's pre grade equivalent score and the national norm for his grade level and projecting this ratio to an hypothetical achievement nine months later.

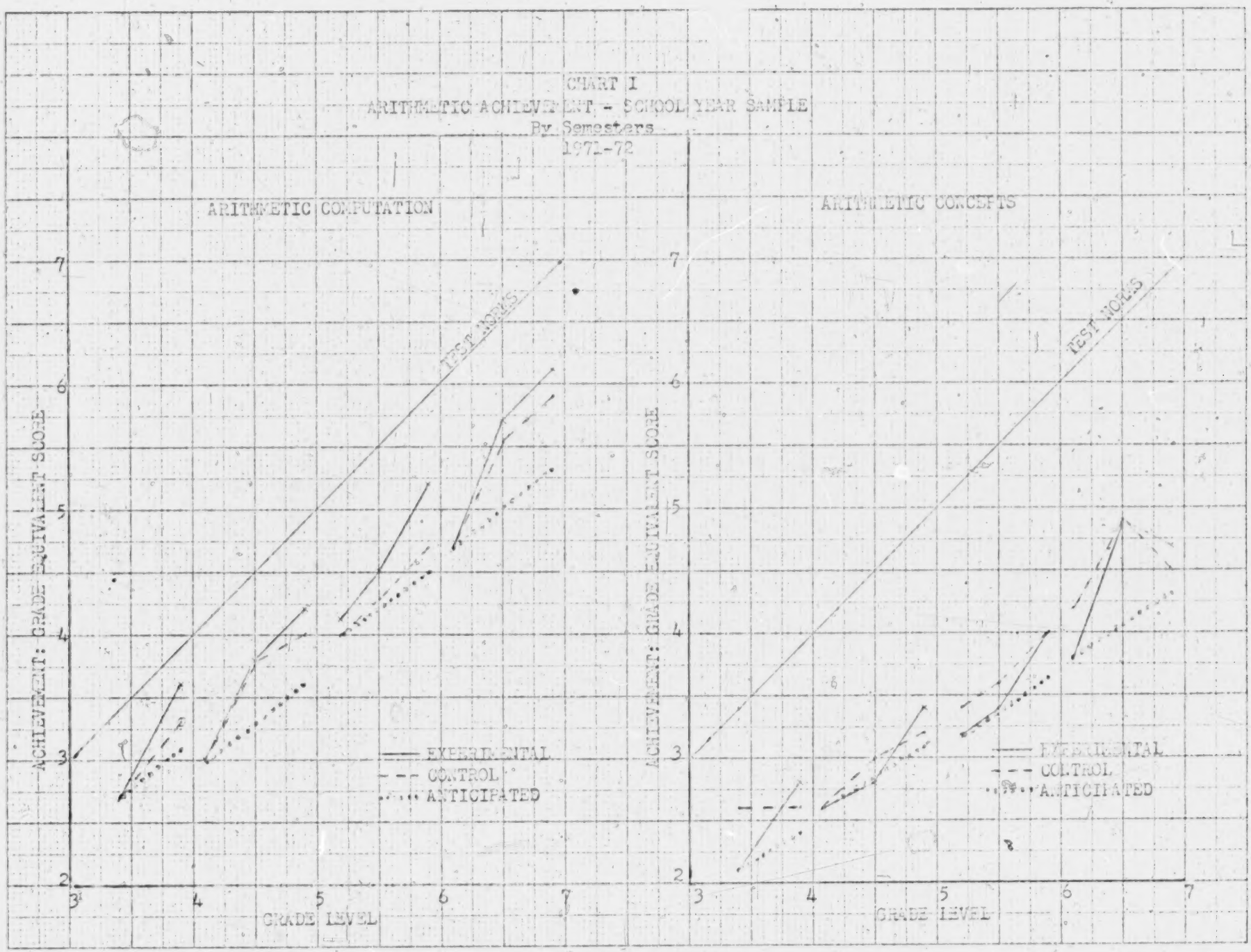
It may be noted that both the experimental and control groups' rate of achievement was greater than the anticipated rate. The cause for this increase could be the influence of the Mathematics Consultant's conferences with the classroom teachers, the awareness of the classroom teachers that these control pupils were in great need of remedial work and could not be served due to the great numbers of eligible pupils. It is also possible that pupils receiving the services of the Mathematics Consultant taught their peers upon their return to the regular classroom. It becomes obvious that in the actual school situation it is impossible to isolate the "control" pupils to keep them free from any influence

CHART I

ARITHMETIC ACHIEVEMENT - SCHOOL YEAR SAMPLE

By Semesters

1971-72



by their peers. Therefore the increased rate of learning by the control pupils can be considered evidence of the indirect influence of the mathematics laboratory on the entire school population. This incidental help of one pupil by another is actually very valuable in the overall picture of aiding pupils learn and achieving the overall goal of greater achievement for all underachievers. However, the effect on the statistical analysis of comparisons between experimental and the "control" pupils is to depress the differences in achievement between the two groups.

The second main analysis of the achievement data utilized a twelve-month period which included the effects of possible regression in achievement during the summer months. Pupil achievement scores obtained in September 1970 were used as covariates in the analysis of pupil scores obtained in September 1971. The achievement data are for the 1970-71 school year and summer 1971 effects on these data.

There was a significant difference ($F = 2.95$, $p < .03$) in the achievement of pupils assigned to the experimental and control groups as measured by achievement scores obtained in September 1971. In the separate subsections of the test it was noted that the majority of this difference was resulting from the achievement in computation, with little difference in achievement noted in the concepts subtest. These data are presented in TABLES VIII and IX.

TABLE VIII

ARITHMETIC COMPUTATION ACHIEVEMENT

Grades 3, 4, 5

September 1970 - September 1971

Group	Mean Grade Equivalent Achievement Scores								
	Grade 3			Grade 4			Grade 5		
	1970	1971	Gain	1970	1971	Gain	1970	1971	Gain
Experimental	2.4	3.0	+0.6	2.8	3.8	+1.0	3.7	4.6	+0.9
Control	2.5	2.7	+0.2	3.0	3.8	+0.8	3.8	4.2	+0.4

Arithmetic Computation: $F = 7.69$, $p < .006$

TABLE IX

ARITHMETIC CONCEPTS ACHIEVEMENT

Grades 3, 4, 5

September 1970 - September 1971

Group	Mean Grade Equivalent Achievement Scores								
	Grade 3			Grade 4			Grade 5		
	1970	1971	Gain	1970	1971	Gain	1970	1971	Gain
Experimental	2.1	2.3	+0.2	2.3	3.0	+0.7	3.0	4.0	+1.0
Control	2.3	2.3	0.0	2.6	3.2	+0.6	3.0	3.6	+0.6

Arithmetic Concepts: $F = 1.40$ non-significant

It would appear that although there was a significant difference between pupils' achievement in experimental and control groups at the end of the school year, by the following fall, this difference has disappeared as far as pupil knowledge of arithmetic concepts is concerned.

The third study analyzed the achievement of these pupils at the end of the second year by: two years of experimental treatment; one year experimental and one year control; or two years assignment to the control group.

The first comparison was between pupils who had been in the experimental groups for two complete years and pupils who had been in the control group for the first year and in the experimental group for the second year. The multivariate analysis calculated an $F = 2.79$, $p < .01$. There is a significant difference between the two groups. However when the individual components of the multivariate F are examined it may be noted the main difference between the groups occurred at the end of the first year, when one group had been experimental and one had been control. By the end of the second year when both groups were experimental, there was no significant difference between the groups. TABLE X presents the univariate F's for the various testing periods.

TABLE X

ARITHMETIC COMPUTATION ACHIEVEMENT

2 - Year Sample

Experimental-Experimental vs. Control-Experimental

Date	Univariate F	P Less than	Least Square Estimate EE - CE
May 1971	10.89	.001	18.20
Sept. 1971	1.65	.199	9.57
Jan. 1972	.14	.711	.61
May 1972	.19	.67	-2.37

Examining achievement data in the area of arithmetic concepts, the multivariate analysis indicated no significant differences in achievement between the pupils who had been instructed in the experimental group for two years and those who were in the control group for the first year and in the experimental group during the second year. The multivariate F = 1.70 was not significant. It would appear that at the end of two years of instruction, pupils who have been in the experimental group are not achieving at a significantly higher level in either portion of the test than those pupils who have been involved in the project for only one year.

The second comparison was between the pupils who had been in the control group for the complete two years and those pupils who had had one year of experimental mathematics and the second year were in the control group. In the area of arithmetic computation there was a significant difference in the achievement of these two groups. The multivariate F = 4.12 was significant at the .001 level. TABLE XI presents the univariate F data.

TABLE XI

ARITHMETIC COMPUTATION ACHIEVEMENT

Control-Control vs. Experimental-Control

2-Year Sample

Date	Univariate F	P Less than	Least Square Estimate EC - CC
May 1971	13.99	.0003	27.15
Sept. 1971	2.42	.12	10.96
Jan. 1972	1.66	.20	11.60
May 1972	0.22	.65	-9.97

Again it may be noted from examining the univariate date the primary point of difference in computational achievement between the pupils in the control group for two years and pupils who had one in the experimental group was only at the end of the first year. By the following September there was no significant difference in achievement between the two groups of pupils.

In examining the arithmetic concepts part of the test, the multivariate F was not significant, indicating that the pupils in the two groups did not achieve arithmetic concepts scores which were significantly different.

The overall conclusion from the two-year study of achievement would seem to be that there is no difference in achievement between pupils who have had two years of work in the experimental group and pupils with only one year of experimental group experience, nor between pupils who were assigned to the control group for two years and those who had one year experience as experimental and one year experience as control. Chart II presents the data for the two-year experimental group and the two-year control group by grade level.

Once more an anticipated rate of achievement was calculated and projected for the two-year period. (Chart III). For these data it may be noted that only for pupils in the sixth grade, who were also experimental group in the fifth grade, was there any appreciable difference in achievement between the control pupils and the achievement anticipated from their former rate of growth. This would seem to indicate that the indirect help, supposed to be aiding classroom teachers and those control pupils in the classroom, although apparent at the end of one year, cannot be documented over a period of two years by a change in the rate of achievement of the control pupils in grades 3, 4 or 5.

CHART II

ARITHMETIC ACHIEVEMENT - 2 YEAR SAMPLE

1970 - 71; 1971 - 72

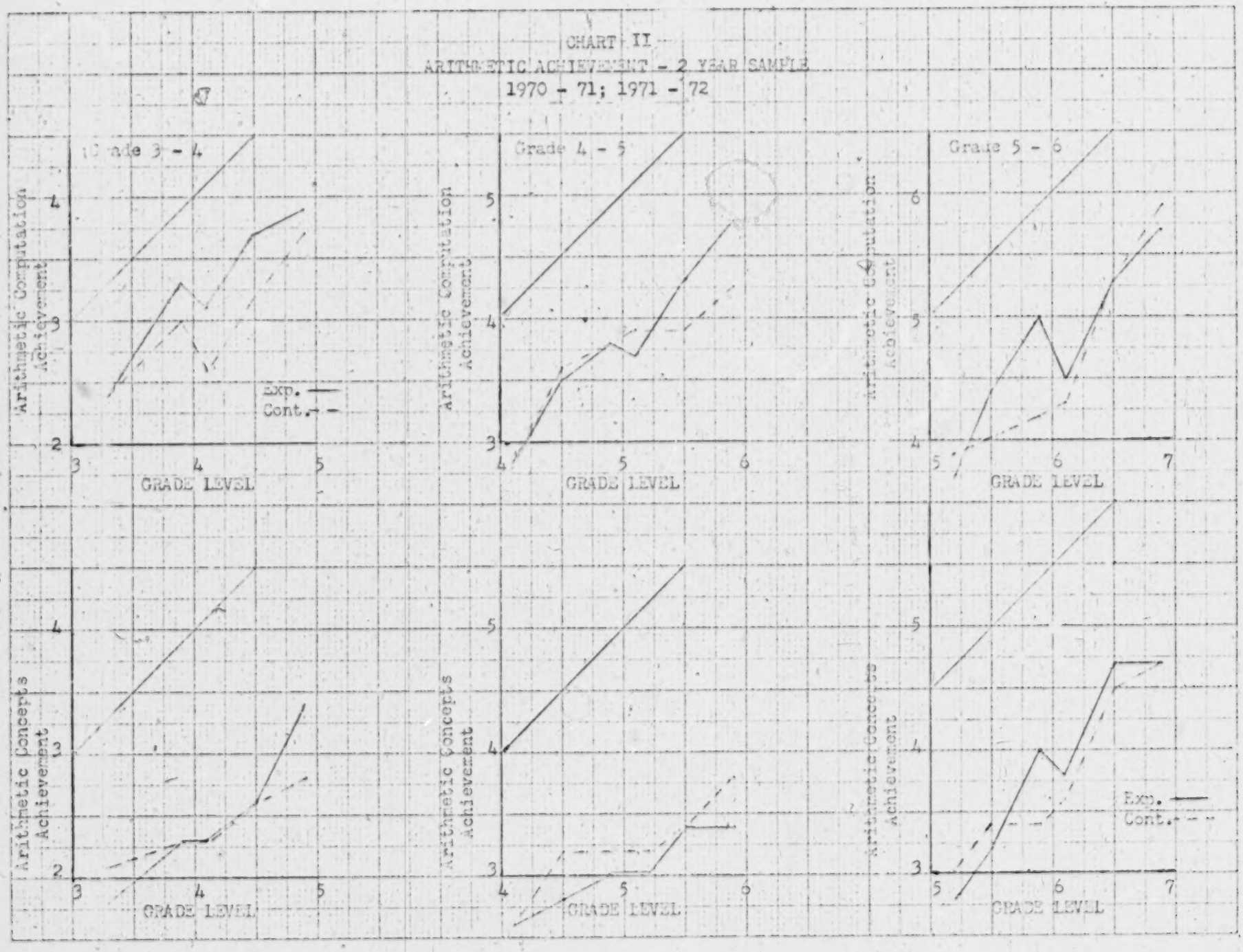
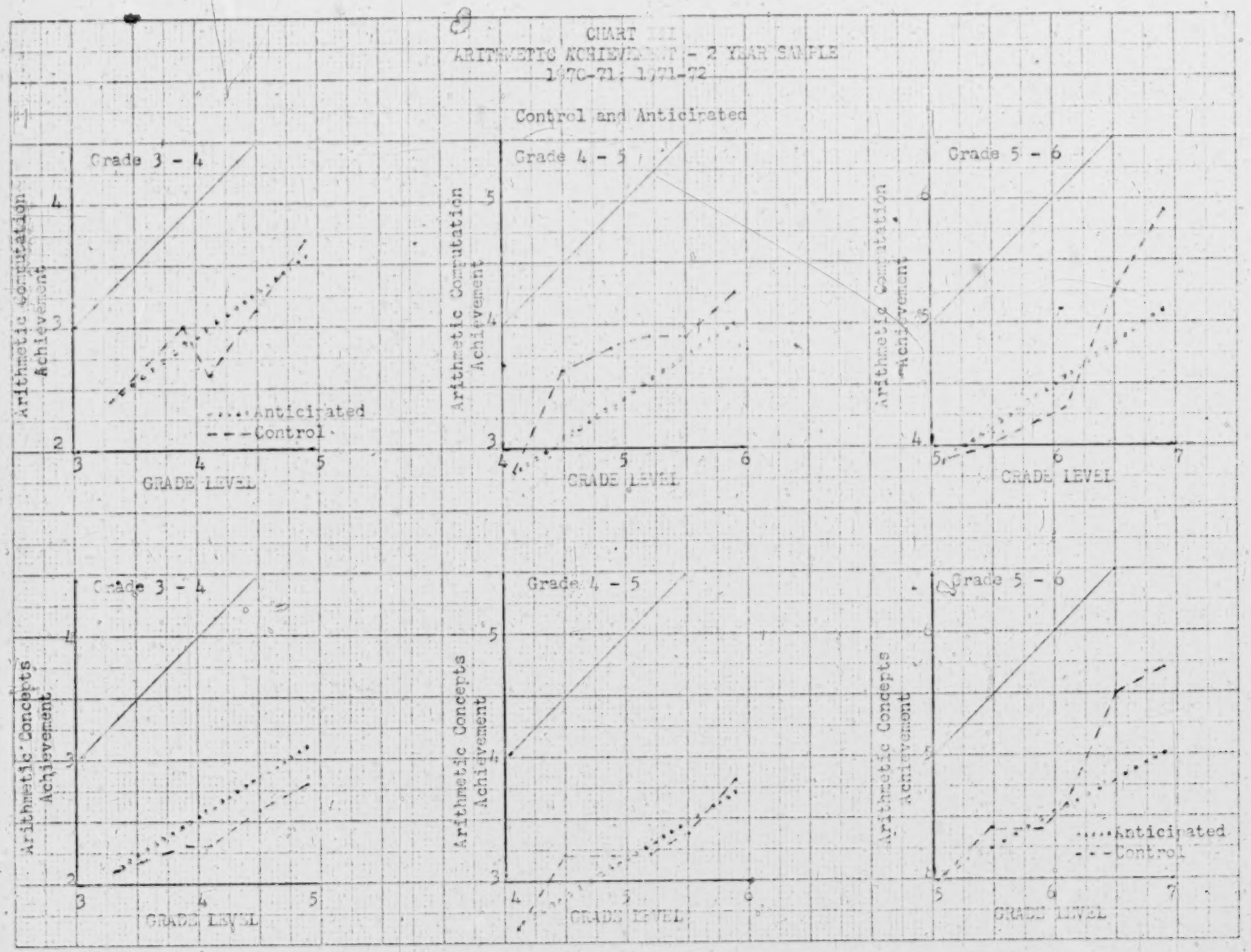


CHART
ARITHMETIC ACHIEVEMENT - 2 YEAR SAMPLE
1970-71; 1971-72

Control and Anticipated



Conclusions - Product Objective 1

When pupil achievement is analyzed for the one-year period, and achievement of pupils in the experimental and control group is compared, significant differences are documented in both arithmetic computation and arithmetic concepts. However, when the data are analyzed for a time period longer than the single school year, the achievement gains disappear and the effect of the additional instruction cannot be found. It is only for the sixth grade pupils who have had two years of instruction have significant differences been documented between the experimental groups, control groups and an hypothetical control achievement.

Product Objective 2: To increase achievement in mathematics of at least 2/3 of the experimental students by 0.45 grade placement for one semester of involvement or 0.90 grade placement for a nine-month period of involvement.

The criterion is that at each grade level two-thirds of the experimental pupils in each target Title I school will achieve at least 0.45 in grade placement gains for one semester of involvement or an average of 0.90 for one school year of involvement in the project.

Achievement data was recorded for a sample of experimental pupils across all project Title I schools. Therefore these data have not been analyzed by school, but rather for the project.

For the school year 1971-72 the criterion was achieved for pupils in grades 3 and 4, but not grades 5 and 6. TABLE XII presents these data.

TABLE XII

ARITHMETIC COMPUTATION ACHIEVEMENT

Numbers of Pupils Making Normal Gains
(0.1 achievement gain for each month of service)

1971-72

	Grade 3		Grade 4		Grade 5		Grade 6	
	No. of Pupils	%	No. of Pupils	%	No. of Pupils	%	No. of Pupils	%
Adequate Gain	22	73.4	20	66.7	16	53.4	15	50.0
Inadequate Gain	8	26.6	10	33.3	14	46.6	15	50.0

Data for pupils having two years of instruction was also compiled to determine whether these pupils, for the two year period, were achieving 0.1 grade equivalent gain for each month of service. TABLE XIII presents these data. It may be noted

that for no grade level did two-thirds of the pupils make adequate gains for the two year period.

TABLE XIII

ARITHMETIC COMPUTATION ACHIEVEMENT GAINS

Numbers of Pupils Making Normal Gains
(0.1 achievement gain for each month of service)

1970-71 & 1971-72

	Grades 3-4		Grades 4-5		Grades 5-6	
	No. of Pupils	%	No. of Pupils	%	No. of Pupils	%
Adequate Gain	3	33.3	25	61.0	46	62.2
Inadequate Gain	6	66.7	16	39.0	28	37.8

It would appear that for these experimental pupils it had not been possible for two-thirds of them to begin to achieve normal gains in computational skills even with the additional mathematics instruction. However it must be noted that pupils in the project for two years are probably the lowest achieving of the eligible pupils. Pupils who made adequate gains the first year automatically would not have been eligible for services the second year. Therefore, these pupils in this sample represent the most difficult group, with the lowest achievement and probably poorest habits in operation. So for this two-year group, the fact that two grade levels had more than 60% of the pupils making normal achievement could be considered as successfully meeting the criterion.

Product Objective 3: To improve significantly ($p < .05$) student's attitude toward arithmetic.

Pupils were not questioned concerning their attitudes toward mathematics nor toward the Mathematics Skills Project. However interviews were conducted by an independent interviewing firm with teacher and principals. These adults were asked for their perceptions of pupil attitudes and feelings toward the project. Forty-seven of the 69 (68%) respondents depicted pupil reaction as favorable with typical comments of:

> "They never want to miss."
> "They bounce in."
> "They leave early for the project sessions."
> "They keep track of the time and remind me when it is time for them to leave."

Of the remaining respondents, 12 teachers (17%) made statements which could be classified as neutral, or mixed, and 10 (15%) viewed pupil reaction as unfavorable. The unfavorable responses were characterized by the following comments:

> "They are not really interested."
> "Their reaction is not often favorable."
> "They don't want to go."

Pupil attitude toward the project was also assessed by inquiring about the attitudes of students not a part of the experimental group. Fifty of the 59 teachers described the reaction of non-participants as one of indifference. Examples of this neutral attitude were:

> "They don't mind having the leave."
> "Some want to go, but most don't care."
> "They don't even realize the child has gone."

Of the remaining teachers, six stated that other pupils wanted to go, too, and three teachers stated that pupils were glad not to have to go. The conclusion drawn by the outside interviewer was:

> The majority of participating pupils are described as being enthusiastic about the project, and resentment among non-participants appeared rare.

V. CONCLUSIONS

According to the process objectives, it would appear that services of the Mathematics Skills Improvement Project have been usually available and delivered to the pupils. However the attendance of pupils in the mathematics laboratories varies widely from one school to the next, ranging from attendance of 57% to 80%. In this area the criterion of pupils achieving 85% attendance was not met.

In the area of pupil achievement, when only one school year's work is assessed it appears that the objectives of the project have been met. However when a longitudinal study is completed for a two year period, the results are less positive. In fact, at the end of a two year period, there is no difference in achievement between eligible pupils with two year's experience in the project, and no years in the project. Over a two year period, the project's effects cannot be noted, and whatever gains are made in the first year have not been maintained through the second year.

APPENDIX A

MATHEMATICS SKILLS IMPROVEMENT PROJECT

School Participation

1968-1972

	Spring 1968	Fall 1968	Spring 1969	Fall 1969	Spring 1970	Fall 1970	Spring 1971	Year 1972
A. A. Benesch		X	X	MES PROJECT				
Anton Grdina		X	X	X	X	X	X	X
Bolton		X	X		X	X	X	X
Chas. H. Lake								X
Charles Orr		X	X		X	X		X
Charles W. CHesnutt				X	X	X	X	X
Chesterfield	X	X	X	X	X		X	X
Columbia	X	X	X	X	X	X	X	X
Crispus Attucks		X	X	X	X	X	X	X
Daniel E. Morgan	X	X	X	X	X	X	X	X
Dike	X	X	X	X	X	X	X	X
Doan								X
Dunham	X	X	X	X	X	X	X	X
George W. Carver		X	X	X	X	X	X	X
Giddings				X	X	X	X	X
Hazeldell	X	X	X	X	X	X	X	X
Hicks								X
Hough	X	X	X	X	X	X	X	X
Iowa-Maple	X	X	X		X	X	X	X
John Burroughs	X	X	X	X	X	X	X	X
John D. Rockfeller		X	X	X	X	X	X	X
John D. Raper	X	X	X	X	X	X	X	X
Joseph F. Landis	X	X	X	X	X			X
Longwood						X	X	X
Margaret Ireland	X	X	X	X	X	X	X	X
Marion				X	X	X	X	X
Mary B. Martin	X	X	X	X	X	X	X	X
Mary M. Bethune	X	X	X			X	X	X
O. W. Holmes	X	X	X	X	X	X	X	X
Quincy	X	X	X	X	X	X	X	X
Rosedale								X
R. B. Hayes		X	SCHOOL DESTROYED BY FIRE					
Sterling		X	X	X	X	X	X	X
Tremont		X	X	X	X	X	X	X
Wade Park		X	X	X	X	X	X	X
Washington Irving	X	X	X	X	X	X	X	X
Wooldridge		X	X	MES PROJECT				
St. Agnes			X			X	X	X
St. Aloysius			X			X	X	

APPENDIX B

	Total # Pupils Enrolled during School Year	# Pupils Enrolled For complete Semester		Entire School Year	Days Attendence Pupils Enrolled Complete Year (180 days) No. of Days MSIP	% of 180
		1st	2nd			
A. Grdina	73	65	63	58	123	68.5
Bolton	74	56	59	51	130	72.3
C.H. Lake	66	60	59	55	144	80.0
Chas. Orr	74	58	50	43	*	
C. Chesnutt	74	59	60	49	109	60.5
Chesterfield	78	59	63	49	123	68.5
Columbia	73	65	59	52	123	68.5
C. Attucks	79	63	57	46	127	70.5
D.E. Morgan	77	62	65	53	137	76.0
Dike	76	56	62	50	103	57.2
Doan	80	53	60	47	125	69.5
Dunham	77	64	65	56	135	75.0
G.W. Carver	69	65	60	57	136	75.5
Giddings	82	62	59	50	*	
Hazeldell (Smith)	78	62	63	53	131	73.0
Hazeldell (Fields)	69	62	60	56	104	57.8
Hicks	83	57	61	43	121	67.3
Hough	77	65	65	56	116	64.5
I. Maple	81	50	62	46	134	74.5
J. Burroughs	42	37	28	26	124	69.0
J. Raper	69	61	62	56	133	74.0
J.D. Rockefeller	87	59	60	43	127	70.5
J. Landis	80	61	58	46	123	68.5
Longwood	71	52	59	46	124	69.0
M. Ireland	71	58	61	51	*	
Marion	50	38	37	27	121	67.4
M.B. Martin	76	58	63	51	110	61.2
M.M. Bethune	81	59	61	47	112	62.3
O.W. Holmes	79	55	61	51	113	62.8
Quincy	73	58	63	49	125	69.5
Rosedale	73	54	56	48	*	
St. Agnes	21	20	20	20	131	73.0
Sterling	23	20	16	14	117	65.0
Tremont	88	49	54	43	113	62.8
Wade Park	82	56	49	43	113	62.8
W. Irving	72	62	59	53	141	78.4
TOTAL	2,578	2,000	2,019	1,684		

*Data not accurate

APPENDIX C

CLEVELAND PUBLIC SCHOOLS

DEPARTMENT OF INSTRUCTION

Division of Research and Development

PARENT QUESTIONNAIRE

Dear Parent:

We are happy that your child was part of a group who were given special instruction in arithmetic. We now wish to know how you feel about this special help. Please help us by circling your answer to the question below.

	"Yes" Number	%	"No" Number	%
1. Did you know your child was receiving special instruction this semester to help him improve in arithmetic?	150	92.5	12	7.5
2. Did you receive any written information about this special arithmetic instruction?	118	74.8	40	25.2
3. Did your child show you any arithmetic papers or other objects from his special arithmetic instruction teacher?	126	78.3	35	21.7
4. Have you talked with your child's special arithmetic teacher?	82	51.2	78	48.8
5. Have you visited your child's special arithmetic class?	60	38.0	98	62.0
6. Did your child talk to you more about this arithmetic this semester than before?	132	82.0	29	18.0
7. Do you feel that the special instruction arithmetic has helped your child improve?	150	96.3	6	3.7

APPENDIX D

Parent Comments on Questionnaire

(14 Schools)

I know he's weak in arithmetic. He usually says he wasn't given any homework in arithmetic.

My son wasn't very enthusiastic about the arithmetic program. Although I know it was a great help to him, he did not like it, so we did't talk about it. I know in the future it will help him and others to understand the math. There also should be a class for parents, so they can understand it.

Well, I'm helping her all I can, and she seems to be trying very hard.

I am thankful for the special attention my son Conrad is receiving, and also I will be coming up to visit with his teacher.

Cheryl seems to enjoy it more than before. She now tries to help her sister and this is really what made me glad.

This was a very good idea. I hope there will be more classes like this one. I only wish we had this type of class when I was in school. Keep the good work up.

I would just like to say thanks for helping my son.

The teacher wrote me a letter about the special arithmetic. But I wasn't able to attend any of the classes. But Danita was very enthusiastic about it; she was always telling me about it.

Calvin has improved in arithmetic this year. I hope he can go again next year.

He doesn't talk much about his school work.

I haven't seen any of Joyce's work from her special class.

I feel that this program has been helpful to Darren and hope that it will continue. I do appreciate this special effort to help the children of this community.

APPENDIX E

KUHLMANN-ANDERSON TEST

Pupils Eligible For Project Services

1971-72

Pupil PLR

	Grade Level				$\bar{X}$
	3	4	5	6	
Exp.	87.9	86.1	87.5	88.5	87.5
Cont.	87.0	85.3	89.0	93.0	88.6
$\bar{X}$	87.5	85.7	88.2	90.8	88.0